Abstract
Dry eye is one of the most common complications following laser-assisted in situ keratomileusis (LASIK), with nearly all patients experiencing some degree of postoperative dry eye symptoms. Postoperative dry eye affects approximately 50% of patients at 1 week postoperatively, 40% at 1 month, and 20%-40% at 6 months postoperatively. LASIK can cause intracorneal nerve damage, goblet cell damage caused by suction, and can cause changes in the shape of the central cornea. Dry eye diagnosis can be made using a questionnaire to determine the patient's history, examination of tear break up time, staining of the eye surface using fluorescein or lissamine green, and Schirmer's test. This research uses literature review methods. Post-LASIK dry eye complaints such as irritation, red eyes, foreign body sensation, pain, gritty, and photophobia. Management of post-LASIK dry eye can be done by giving tear supplements, anti-inflammatory agents, ointments and eye patches, and treatment of meibomian gland dysfunction. Post-LASIK dry eye usually peaks within a few months after surgery, and then improves in most patients 6-12 months after surgery. Although dry eye signs and symptoms are most common in the immediate postoperative period and are usually only temporary, a minority of individuals experience chronic and severe dry eye symptoms.

Keywords: Lasik; Dry Eye; In Situ Keratomileusis.
Introduction

LASIK is the most popular and widely used technique. Approximately 600,000 individuals, usually in their 30s undergo LASIK or a similar procedure each in the United States. Its popularity in the country has declined from a peak of 1,400,000 procedures in 2006 for reasons that are not entirely clear, although millions of people worldwide, particularly in Asia, still opt for refractive surgery (Wilkinson, Cozine, and Kahn 2017). Dry eye after laser in situ keratomileusis (LASIK) is the most common problem faced by refractive surgeons, with almost all patients experiencing dry eye after surgery, usually temporary (Cohen and Spierer 2018). Dry eye disease affects hundreds of people around the world. According to the International Dry Eye Workshop II (DEWS II) 2017, dry eye is a multifactorial disease of the ocular surface characterized by loss of homeostasis of the tear film, and is accompanied by ocular symptoms, instability and increased osmolarity of the tear film, damage and inflammation of the ocular surface, and neurosensory abnormalities (im ek et al. 2018). The tear film has a thickness of about 2-5 mm above the cornea and consists of three main components, namely the lipid layer, the aqueous layer, and the mucin layer. The Women's Health Study and the Physician's Health Study reported a higher incidence of dry eye in women (3.2 million) compared to men (1.6 million) over the age of 50 (Wijaya 2018).

Laser Assisted In Situ Keratomileusis (LASIK) is a safe and effective surgical option for the treatment of refractive errors however, dry eye is a very common consequence after LASIK surgery, with up to 95% of patients experiencing dry eye symptoms following corneal refractive surgery. Although dry eye signs and symptoms are most common in the immediate postoperative period and are usually only temporary, a minority of individuals experience chronic and severe dry eye (5). Postoperative dry eye affects approximately 50% of patients at 1 week postoperatively, 40% at 1 month, and 20%-40% at 6 months postoperative (6). Corneal refractive surgeons also report dry eye as the most common complication of LASIK (Shtein 2011).

Method

Literature review is a scientific study that focuses on one particular topic. Literature review will provide an overview of the development of a particular topic. Conducting review literature is the same as conducting activities: 1) data collection / information, 2) evaluating data, theory, information or research results, and 3) analyzing the results of publications such as books, research articles or others related to research questions that have been prepared before.

Result and Discussion

Definition

Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbances, and tear instability with potential damage to the ocular surface (Shtein 2011).

Epidemiology

The prevalence of dry eye symptoms before undergoing LASIK is estimated to be between 38-75%. After LASIK, it has been widely demonstrated that the majority of patients complain of dry eye symptoms, especially in the early period of surgery. After the LASIK method, 95% of patients reported some dry eye symptoms. Dry eye symptoms
were reported in 60% of patients after 1 month of LASIK. Post-LASIK dry eye usually peaks within a few months after surgery and then improves in most patients 6-12 months after surgery. Postoperative dry eye affects approximately 50% of patients at 1 week postoperatively, 40% at 1 month, and 20%-40% at 6 months postoperative (Toda 2018). Estimates of the incidence of dry eye syndrome after LASIK vary widely, but almost all patients will experience temporary dry eye during the postoperative period, with the greatest incidence of dry eye after surgery at one week. One study found that 94.8% at 1 day after surgery, 85.4% at 1 week, and 59.4% of patients experienced dry eye symptoms at 1 month after surgery (Cohen and Spierer 2018).

**Prolonged Dry Eye Risk Factors**

The most significant risk factor for dry eye developing severe after LASIK surgery is pre-existing dry eye. Preoperative tear volume can affect the recovery of the ocular surface after LASIK, increasing the risk of chronic dry eye. A Schirmer test value of less than 10 mm before surgery is a specific indicator for experiencing dry eye symptoms after LASIK. Ocular surface staining, low corneal sensation, and dry eye symptoms before LASIK correlated with a higher risk for chronic dry eye after LASIK. Subjects requiring higher refractive correction have an increased risk of developing dry eye. Patients undergoing LASIK for high myopia (range: 9.10 to 14.00 D) reported ongoing dry eye symptoms 2–5 years after surgery (Cohen and Spierer 2018).

A genetic influence was also observed with polymorphisms in the thrombospondin 1 (THB S1) gene found to be associated with post-refractive surgery of chronic ocular surface inflammation (Contreras-Ruiz et al. 2014). A long-term history of wearing contact lenses before LASIK may contribute to delayed recovery in tear secretion and corneal sensitivity after surgery (Cohen and Spierer 2018). Asian races have a higher prevalence of post-LASIK chronic dysfunction and dry eye symptoms, according to one study 28% of Asian patients suffer from dry eyes compared to 5% among Caucasian patients after LASIK surgery. Contributing factors may include eyelid and orbital anatomy, tear film parameters, and blinking, as well as higher refractive effort rates of correction in Asian eyes (Albietz, Lenton, and McLennan 2005).

**Pathophysiology of Dry Eye Due to LASIK**

The mechanism involved in dry eye after LASIK surgery is not fully understood, but it is thought to result from a temporary denervation state of the cornea caused by the creation flap (i.e. a thin layer or fold of the cornea) resulting in decreased corneal sensitivity (Toda 2018). LASIK can disrupt the dense sub-basal nerve plexus and corneal stromal nerves by anterior stromal flap formation and corneal ablation by the excimer laser (Shtein 2011). Decreased corneal sensitivity can affect the corneal lacrimal gland and the corneal blink reflex, which will lead to decreased tear secretion and blink reflex (Toda 2018). The blink reflex controls the secretion of the lipid layer produced by the meibomian glands. A decreased level of the blink reflex can cause the meibomian glands to inhibit the secretion and excretion of fatty substances on the tear film (tear film). delayed evaporation and tear clearance due to decreased lipid layer secretion (Toda 2018).

Nerve disorders in the cornea can also alter mucin expression in the epithelium, which can lead to decreased tear stability. Changes in mucin expression can occur in
various ocular surface disease states, including dry eye. Song et al, reported that experiments on mice found lower MUC-4 mucin expression in neurotrophic disorders caused changes in ocular surface homeostasis resulting in dry eyes (Toda 2018). In a study conducted by Li et al who evaluated corneal reinnervance in response to corneal sensitivity after Small Incision Lenticule extraction (SMILE) and LASIK with in vivo microscopy, it was found that in both groups, subbasal nerve density decreased after surgery compared to before surgery. Although corneal sensitivity significantly decreased postoperatively in both groups, the reduction was significantly greater in the 1-week, 1-month, 3-month, and 6-month rice LASIK groups. These data support the hypothesis that corneal denervation plays a major role in dry eye (Toda 2018).

In LASIK procedures, the femtosecond laser can cause a transient elevation of pressure on the conjunctiva caused by the suction ring (straws) femtosecond so can damage the conjunctival goblet cells and reduce the mucin secretion causes changes in corneal epithelial mucin expression and decreased TBUT (Toda 2018). The film breakup time tear(TBUT) is the time it takes for the tear film to break after the blink of an eye. This quantitative examination is useful for assessing the stability of the tear film, and the normal time for TBUT is 15-20 seconds, whereas in dry eyes the TBUT value is 5-10 seconds (Wijaya 2018). In LASIK surgery there will be changes in the curvature and smoothness of the cornea which can change the friction of the cornea and eyelids resulting in the instability of the tear film (Toda 2018).

Figure 1. Pathophysiology of dry eye due to LASIK (Toda 2018)

Postoperative inflammatory changes can also cause post-LASIK eye dryness.

Inflammation of the nerve endings can directly stimulate pain through pressure or other direct action on the nerves (Shtein 2011). It is hypothesized that the postoperative inflammatorymay contribute to diffuse inflammation on the ocular
Ocular surface dryness is known to be associated with chronic inflammation of the ocular surface, and the presence of inflammatory cytokines in the ocular lining and conjunctival epithelium (Shtein 2011).

**Diagnosis**

**Sequence of dry eye examination include:**

1. **History of Patient history with questionnaire**
   Several questionnaires that can be used include the Ocular Surface Disease Index (OSDI), Impact of Dry Eye on Everyday Life (IDEEL), McMonnies, and Women's Health Study Questionnaire (Tsubota et al. 2017). OSDI is the most frequently used questionnaire for the diagnosis of dry eye disease if the score is above 30 (Baudouin et al. 2014).

2. **Tear film break-up time with fluorescein**
   The tear film breakup time (TBUT) is the time it takes for the tear film to break after the blink of an eye. This quantitative examination is useful for assessing tear film stability, and the normal time for TBUT is 15-20 seconds, whereas in dry eyes the TBUT value is 5-10 seconds (Tsubota et al. 2017).

3. **Staining the surface of the eye using fluorescein or lissamine green**
   Staining the surface of the eye using fluorescein is more used to assess the severity of the corneal epithelium and lissamine green stain to assess the conjunctiva (Wijaya 2018).

4. **Schirmer Test**
   Schirmer I test to assess tear production by the lacrimal gland for 5 minutes (Wijaya 2018).

5. **Examination of the eyelids and meibomian glands, namely by assessing the condition of the meibomian glands in the eyelids** (Wijaya 2018).

**Figure 2. (A)staining of the Fluorescein cornea. (B)green staining of the Lysamine conjunctiva (Wijaya 2018)**
Figure 3. (A) Illustration of examination Schirmer I, strip Schirmer placed on the cul-de-sac inferior near the lateral canthus. The aqueous production of the right eye is abnormal. (B) Dysfunction of the meibomian glands of the lower eyelid margin (Wijaya 2018).

Post-LASIK Dry Eye Clinical Manifestations

Symptoms of dry eye after LASIK:

Patients may complain of irritation, red eyes, foreign body sensation, pain, grittiness, and photophobia (Cohen and Spierer 2018). Postoperatively, 20% to 40% of patients report symptoms such as dry eye, burning, itching, discomfort, or dryness of the ocular surface. Various visual symptoms, such as glare, halos, burning sensation, and reduced contrast sensitivity, affected up to 20% of patients in the PROWL study. These symptoms are especially bothersome when the patient is driving at night (Wilkinson, Cozine, and Kahn 2017). Impaired tear function can impair the integrity of the ocular surface, resulting in decreased vision and fluctuations in vision in about 10% of patients. Functional visual acuity was defined as visual acuity after 10 seconds of keeping the eyes open and was found to decrease after LASIK surgery (Cohen and Spierer 2018). The decrease in visual acuity after LASIK is more common in post-LASIK patients than in other dry eye patients (Toda 2018). These symptoms usually peak in intensity about three months after the procedure and usually resolve after 6-12 months, with up to 20% of patients having persistent symptoms (Cohen and Spierer 2018).

Clinical Signs of Post-LASIK Dry Eyes:

Positive vital stains on the ocular surface, especially the corneal flap with fluorescein, rose bengal, and lissamine green. Tear Break Up Time (TBUT) was shortened within 1 week after surgery and continued for an average of 3 months. Tear secretion was determined by the test Schirmer was under anesthesia and was found to be significantly decreased postoperatively over 6 months (Toda 2018).

Governance

Post-LASIK dry eye management is the same as a non-LASIK dry eye treatment, including:

a. Tear supplements

Preservative-free artificial tears are essential for dry eye care. Can use 0.3% hyaluronic acid administered 5 times daily for 1 month (Toda 2018).
b. Agent

Anti-inflammatory-cyclosporine 0.05% ophthalmic emulsion is known to be effective for patients with a chronic dry eye whose tear production is suppressed by inflammation. Rebamipide is known to have an anti-inflammatory effect by suppressing inflammatory cytokines in tears. A retrospective study comparing patients in whom the standard postoperative eye drop regimen was followed with patients in whom 0.05% cyclosporine A (Restasis) was added to the standard regimen for 12 weeks found that 0.05% cyclosporine A was associated with better and better recovery, fast overall (Toda 2018). The mean spherical refraction in eyes treated with 0.05% cyclosporine A was significantly closer to the desired target at 3 and 6 months after LASIK than in eyes treated with artificial tears only (Cohen and Spierer 2018).

c. Ointments and eye patch (blinkers)

Some patients keep their eyes slightly open eyelids while sleeping. The surface of the eye is more fragile after LASIK and can lead to disastrous complications such as epithelial defects, recurrent erosions, and delayed wound healing of the flaps. So the patient was instructed to wear an eye patch while sleeping and to use an ointment for 1 month after LASIK (Toda 2018).

d. Treatment of Meibom Gland Dysfunction

MGD can cause excessive tear evaporation after LASIK. Warm towel compresses or disposable eyelid warmers may be applied for 5 minutes, twice daily for 2-4 weeks postoperatively (Toda 2018).

Conclusion

Dry eye disease is a multifactorial disease of the tears and ocular surface that causes discomfort, visual disturbances, and tear film imbalance with the potential to damage the ocular surface. This condition can be followed by an increase in tear film osmolarity and inflammation of the ocular surface. One of the etiology of dry eye is LASIK, which is an operative therapy for refractive disorders. Dry eye symptoms were reported in 60% of patients after 1 month of LASIK. Post-LASIK dry eye usually peaks within a few months after surgery, and then improves in most patients 6-12 months after surgery. LASIK can cause nerve damage in the eye and can trigger an inflammatory reaction that can cause dry eyes. Therefore, proper management is needed to treat dry eyes, such as giving tear supplements, eye ointments, and anti-inflammatory drugs. Although dry eye signs and symptoms are most common in the immediate postoperative period and are usually only temporary, a minority of individuals experience chronic and severe dry eye.
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